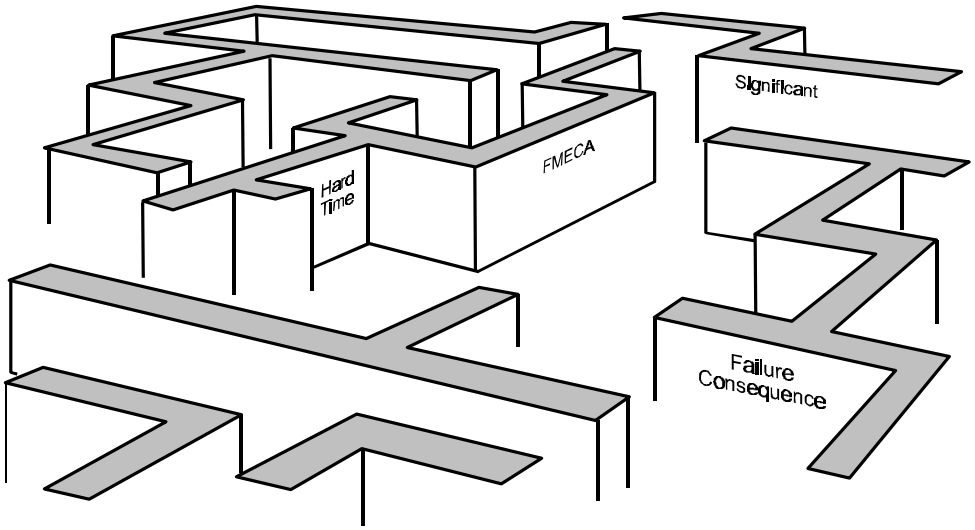
USER'S GUIDE

Navigating And Using IRCMS 6.0



Naval Air Systems Command

IRCMS

Reliability-Centered Maintenance Analysis System For Windows

Manual version: 6.0.1

This page intentionally left blank

Table of Contents

1. INTRODUCTION

1.1 Overview of IRCMS

1.1.1 What Is IRCMS?

The Integrated Reliability-Centered Maintenance System (IRCMS) program is a software tool that was created to assist the Reliability-Centered Maintenance (RCM) analyst in performing and documenting RCM analyses for Naval Air Systems Command (NAVAIR) programs.

- It aids in providing the justification and traceability required for each preventive maintenance task that results from the RCM analysis.
- The IRCMS software leads the user through the RCM logic based on data supplied by the user.
- IRCMS also provides tools to assist in packaging the preventive maintenance requirements that result from the RCM analysis into an integrated maintenance program.
- IRCMS follows the RCM logic contained in NAVAIR 00-25-403, Guidelines For The Naval Aviation Reliability-Centered Maintenance Process.

IRCMS is written to operate in a Windows 95 or Windows NT environment. The programming language used to write IRCMS is Visual Basic 5.0 (32 bit). IRCMS is designed to be run from a local area network. Multiple users can access an IRCMS project at the same time, but access is limited to one user at a time at or below the function level.

> Please note that the IRCMS software is only a tool that assists a knowledgeable RCM analyst. NAVAIR strongly discourages those without a solid grasp of RCM theory from using IRCMS to perform an analysis and assumes no liability for erroneous analyses performed in such a manner.

1.1.2 Features

To assist you in performing an RCM analysis, IRCMS has been designed with the following features:

- Operates in a Windows 95, 98 or NT environment
- Designed to operate on a local area network
- Allows multiple users to access an IRCMS project at the same time
- Allows users to be assigned different access levels based on their needs.
- Saves data when you exit a screen. In the event of a crash, lost data is limited to just one screen of data.
- Provides tools for packaging the resulting preventive maintenance requirements
- Allows users to keep track of total cost of the resulting preventive maintenance requirements and return on investment from the application of RCM (use the Cost Analysis button located on the failure mode screen)
- Keeps an audit trail at the failure mode level of each revision made to the analysis
- Provides an Indication of the status of an analysis
- Allows the user to view the analysis through several different filters (most current revision only, approved analyses, etc.)
- Provides reporting capability at the level specified by the user. Users can also have the data sorted as desired
- Provides an extensive help system which includes help topics, help index and help search capabilities
- Provides easy access to many common editing features by right clicking on an item.

1.1.3 Technical Assistance

The following sources of information should be helpful in navigating IRCMS and performing RCM analyses:

IRCMS Help System
Contains information on using and navigating IRCMS - Available from the help button in IRCMS.

IRCMS User's Guide
Contains information on using and navigating IRCMS. Available from the IRCMS page of the NAVAIR RCM web site.

IRCMS page of the NAVAIR 3.2 web site:
Contains the following services:

- Answers to Frequently Asked Questions
- Description of error messages
- Reporting a problem with IRCMS
- Downloading new versions of the user's manual or IRCMS
- Submitting suggestions for improving IRCMS
- Access to other useful information

NAVAIR 00-25-403 RCM Guidance Manual
Provides in-depth information about NAVAIR's RCM methodology. All IRCMS users must read and be familiar with the contents of this document before performing an analysis. Available from the 00-25-403 page of the NAVAIR RCM web site.

NAVAIR 3.2
For assistance call (301) 757-8227 /8317 /8233 (Since these numbers may change from time to time, check the NAVAIR RCM web site for the most up-to-date contact information).

For more information about RCM go to the NAVAIR RCM web site at
http://www.nalda.navy.mil/3.2/rcm

1.2 Installing IRCMS

1.2.1 Software requirements

IRCMS only requires that the computer system it is installed on uses Windows 95, 98 or Windows NT.

1.2.2 Hardware Requirements

IRCMS requires the following hardware requirement.

- 486 or better PC
- At least 8MB RAM
- XX MB Free disk space for IRCMS files
- XX MB Free disk space for temporary setup files

1.2.3 Installation Instructions

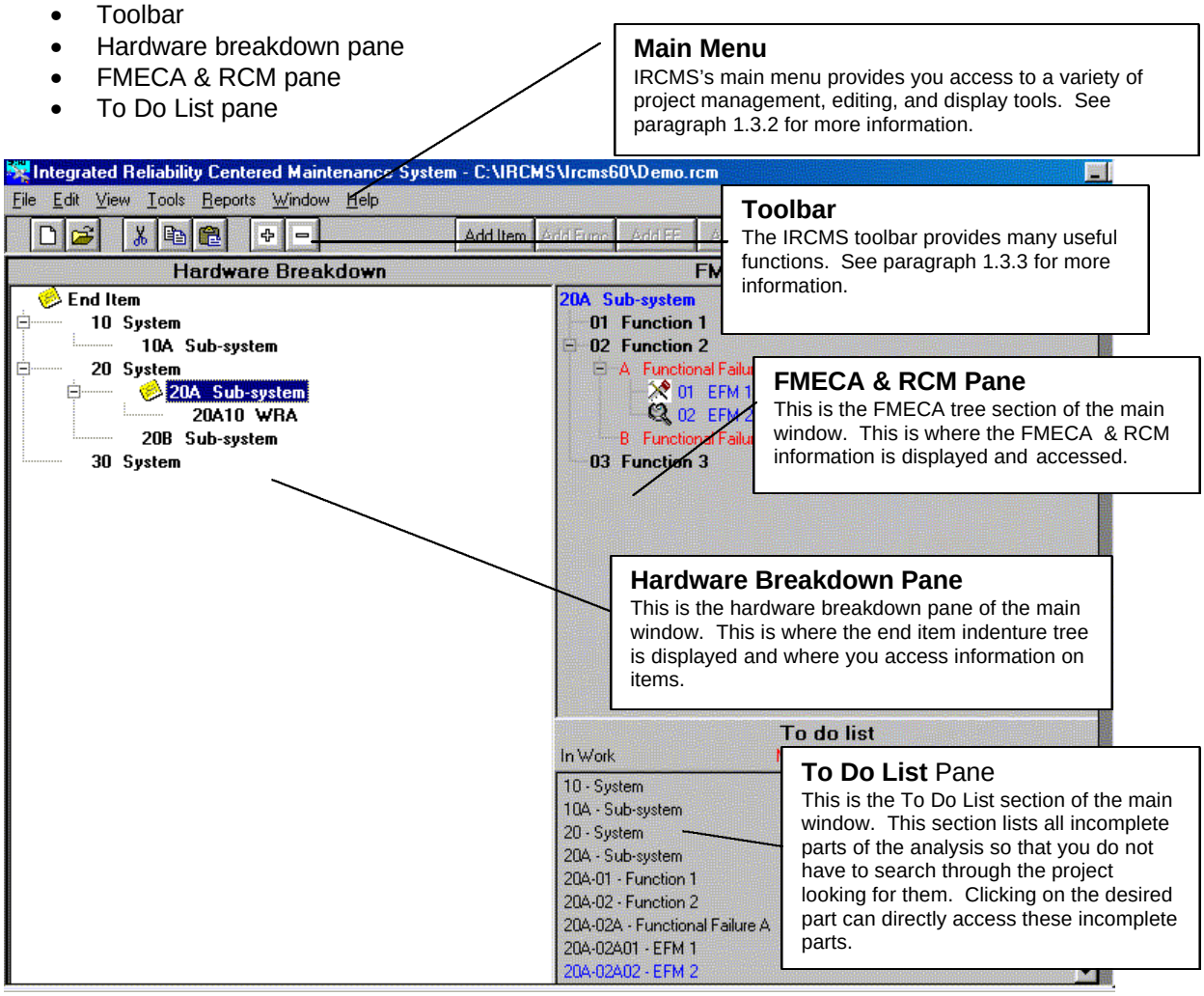
1. Download and unzip the IRCMS program file from the NAVAIR RCM web page (http://www.nalda.navy.mil/3.2/rcm).
2. Run the **SETUP.EXE** file. The setup program leads you through the installation process – just follow the on-screen instructions. The setup program adds the IRCMS icon to your desktop and the IRCMS program to Window's program menu.

1.3 Navigating

1.3.1 IRCMS's Main Window

IRCMS's main window is divided into five main sections:

- Main Menu
- Toolbar
- Hardware breakdown pane
- FMECA & RCM pane
- To Do List pane



Main Menu
IRCMS's main menu provides you access to a variety of project management, editing, and display tools. See paragraph 1.3.2 for more information.

Toolbar
The IRCMS toolbar provides many useful functions. See paragraph 1.3.3 for more information.

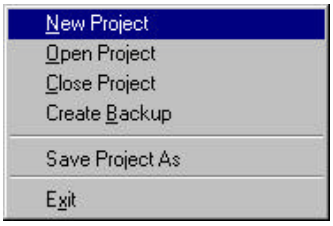
FMECA & RCM Pane
This is the FMECA tree section of the main window. This is where the FMECA & RCM information is displayed and accessed.

Hardware Breakdown Pane
This is the hardware breakdown pane of the main window. This is where the end item indenture tree is displayed and where you access information on items.

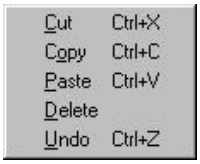
To Do List Pane
This is the To Do List section of the main window. This section lists all incomplete parts of the analysis so that you do not have to search through the project looking for them. Clicking on the desired part can directly access these incomplete parts.

1.3.2 IRCMS's menus

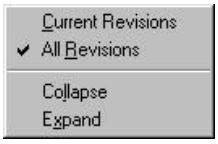
IRCMS's main menu provides you access to a variety of project management, editing, and display tools. The following sub menus are provided:



File - Provides functions for managing projects.

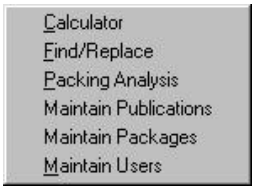


Edit - Provides functions for manipulating project data.



View - Provides functions for controlling how data is displayed in IRCMS.

Tools - Provides access to a calculator, Find & Replace search, and the Packaging Analysis



Reports - Provides access to built-in reports.

Window - Provides functions for navigating between windows.

Help - Provides access to the IRCMS help system.

1.3.3 IRCMS's Toolbar

The following buttons provide you with many useful functions.

 **New** – Creates a new Project.

 **Open** - Opens the Project specified by the user.

 **Cut** - Cuts the selected branch of the analysis.

 **Copy** - Copies the selected branch of the analysis.

 **Paste** - Pastes a **Cut** or **Copied** branch under the selected branch of the analysis.

 **Expand** - Displays all items under the selected item.

 **Collapse** - Hides all items under the selected item.

Brings up a blank item screen for adding a new item.

Brings up a blank function screen for adding a new function.

Brings up a blank functional failure screen for adding a new functional failure.

Brings up a blank failure mode screen for adding a new failure mode.

1.3.4 Icons used in IRCMS

The  icon is displayed next to a hardware item if there is any FMECA data associated with that item. No icon is displayed for hardware items that do not have FMECA data associated with them.

The following icons, which may be displayed next to a failure mode, are used in IRCMS to indicate the status of an analysis:

 - **Approved**. Analyst with approval authority has marked this failure mode as approved.

 - **Needs update**. Failure mode has been marked as requiring update.

 - **Awaiting review**. Failure mode has been marked as awaiting review.

 - **In process**. Analysis is in the process of being updated, but is not yet ready for approval.

 - **Historical**. Analysis is being kept as a historical record. It can be compared to the currently approved analysis to provide an audit trail of changes made.

1.4 Conducting an RCM analysis with IRCMS

IRCMS makes it easy for a knowledgeable RCM analyst to conduct and document an RCM analysis. In general, a new analysis should follow these steps:

- Begin a new project
- Enter information about an item
- Enter failure modes and effects data
- Evaluate preventive maintenance tasks
- Choose the best option
- Package the resulting preventive maintenance requirements
- Update Analysis

1.4.1 Beginning a new project

All data for an RCM analysis, including historical data, is stored in a project. The first thing you need to do to perform an RCM analysis using IRCMS is to *create a new project* (see paragraph 2.1). This will create the project database and allow you to set up the list of authorized users of the project.

Once the project has been created, the next step in the analysis is to enter information about analysis items.

1.4.2 Entering Information About an Item

Once a project has been created, an end item breakdown that graphically displays the end item, its systems, sub-systems, etc. down to the analysis item must be built. Although an analysis item can be entered by itself, it is recommended that you build an indenture tree that starts with the end item and ends with the analysis item. The end item is entered when a project is created. To build the rest of the indenture tree:

1. Add the system that the analysis item is in (see paragraph 3.1 *How To Add An Item*).
2. Continue entering lower indenture items until the analysis item has been added.

Note: Each item that is added will require an item screen to be filled out. IRCMS graphically displays the breakdown you create in the *Hardware Breakdown* pane of IRCMS's main window .

Once the item information has been entered, the next step in the analysis is to enter failure mode and effect information.

1.4.3 Entering Failure Mode and Effect Information

After the analysis item has been added, information about how the item can fail must be added. This information includes:

- Functions of the analysis item (see paragraph 3.2),
- Functional failures of each function (see paragraph 3.3),
- Failure modes (and related information) of each functional failure (see paragraph 3.4)

Each of these requires a new screen to be filled out. This new information will be added to the *FMECA & RCM* pane of the IRCMS's main window allowing easy access to any level of information at just a click of the mouse.

Once the failure mode and effect information has been entered, the next step in the analysis is to evaluate preventive maintenance tasks.

1.4.4 How To Evaluate Preventive Maintenance Tasks

After the failure modes have been entered, preventive maintenance tasks can be evaluated in accordance with approved RCM methods. For information on these methods, see the NAVAIR 00-25-403 manual .

To do this:

1. Select the failure mode to analyze by left clicking on it.
2. Open the failure mode screen by right clicking and selecting **Open** from the pop-up menu.
   Depending on the data entered to this point, some or all of the task evaluation tabs will be accessible according to the RCM logic
3. Click on the Failure Consequence tab and fill in information.
4. Click on appropriate task tabs and fill in information.

Once the preventive maintenance tasks have been evaluated, the next step in the analysis is to choose the best option.

1.4.5 How To Choose The Best Option

Once the applicable task options have been analyzed, compare all valid options, including redesign and no PM, to determine the best preventive option for the failure mode.

To do this:

1. Use the built in cost comparison equations (see section 8) to calculate a *cost per unit operating time* for each valid option (access the equations by clicking on the Cost Analysis button found on the failure mode screen).
   or use another comparison method approved by your program.
2. Document your decision on the **Package/Summary** tab. Be sure to document what method was used to arrive at your decision.

Once the best option has been chosen, the next step in the analysis is to package the resulting tasks.

1.4.6 Packaging Preventive Maintenance Tasks

Any preventive maintenance requirements that come out of the RCM analysis must be packaged into either a new package or into the existing package. Packaging decisions can be recorded on the **Packaging/Summary** tab of the failure mode screen or in the **Packaging Analysis**.

To use the Packaging Analysis:

1. From the **Tools** menu, select **Packaging Analysis**.
2. Select desired filters and sorts from Packaging Menu.
3. Assign Packaged intervals to all preventive maintenance tasks.

Once the resulting tasks have been packaged, the next step in the RCM process will be to update the analysis as needed.

1.4.7 Update Analysis

RCM analyses must be maintained throughout the life of the system. IRCMS provides editing capability and a way to save historical information when revisions must be made to the RCM analysis. Before the analysis is approved, or for minor changes like spelling corrections, changes should be made by simply editing the existing data.

If the analysis has been approved, and a revision is necessary, IRCMS allows you to mark the current analysis as **Historical** and create the revised analysis as described below.

To revise the analysis for a failure mode, follow these steps:

1. Select the failure mode by **left clicking**
2. **Right click** on the selected failure mode
3. Choose Mark historical

The old information is retained by IRCMS and its status is changed to ***Historical*** (IRCMS also marks historical data on the main screen by using the  icon).

IRCMS then creates a copy of the old information and opens it for revision.

Note: You can control whether historical data is displayed on the main window or not by using the options on the **View menu** .

This page intentionally left blank

2. CREATING, OPENING, CLOSING PROJECTS

2.1 How to create a new project

1 Click  ,
or choose New Project from the File menu.
2 In the project name box, type a name for the project.
3 Click Create.
4 Enter access information about project users (see 3.5).
5 Add the end item.

2.2 How To Open A Project

1 Click  ,
or Open Project from the File menu.
2 In the Look In box, click the drive that contains the project.
3 In the box beneath Look In that lists folders and files, double-click the name of the folder that contains the project. Continue double-clicking subfolders until you open the subfolder that contains the project.
4 In the list of files, click the project name.
5 Click Open.

2.3 How To Close A Project

On the File menu, click Close Project.

2.4 How To Save A Project

There is no need to save a project since project data is saved as each screen is exited using the **Save** or **Continue** buttons.

2.5 How To Save Project As

1 Click on Save Project As in the File menu.
2 In the Look In box, click the drive that you want to save the project in.
3 In the box beneath Look In that lists folders and files, double-click the name of the folder that you want to save the project in. Continue double-clicking subfolders until you open the subfolder that you want to save the project in.
4 In the project name box, type a project name.
5 Click Save.

2.6 How To Backup A Project

Click on Create Backup in the File menu. IRCMS creates a copy of the current project with the ".bak" file extension and stores it in the current directory.

2.7 How To Exit IRCMS

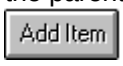
Click on Exit in the File menu.

This page intentionally left blank

3. ADDING INFORMATION TO A PROJECT

3.1 How To Add An Item

In the Hardware Breakdown pane,

1. Click on the parent item under which the new item will be added.
2. Click on 

,
or right click on parent item and choose Add Item.

3.2 How To Add A Function

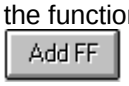
In the FMECA & RCM pane,

1. Click on the item under which the new function will be added.
2. Click on 

,
or right click on the selected item and choose Add Function.

3.3 How To Add A Functional Failure

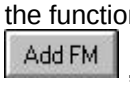
In the FMECA & RCM pane,

1. Click on the function under which the new functional failure will be added.
2. Click on 

,
or right click on the selected function and choose **Add Functional Failure.**

3.4 How To Add A Failure Mode

In the FMECA & RCM pane,

1. Click on the functional failure under which the new failure mode will be added.
2. Click on 

,
or right click on the selected functional failure and choose Add Failure Mode.

3.5 Setting up access levels in IRCMS

IRCMS allows different users to be assigned different levels of access to data based on how they will use the data. Before a user can access data in a project, the user information must be entered and an access level assigned.

When a project is created, at least one user must be entered at that time. At any time during the development of a project new users may be added, and access information for current users can be edited. This is done using the *Maintain Users* option under the Tools Menu .

The following information is stored for each user:

- First name
- Last name
- User name
- Password
- Access level

The access levels that IRCMS uses are:

- **View only -** Users who do not need to be able to edit data, but do need to be able to view data.
- **Analyst** - Users who need to be able to edit data.
- **SignOff** - Users who review new or revised analyses and have approval authority.

3.6 Maintaining Publication List

Preventive Maintenance tasks that result from the RCM analysis will be documented in a maintenance publication of some sort (MRC deck, IMC specification, etc.). During the packaging of preventive maintenance tasks, tasks can be assigned to one of the listed publications.

This feature of IRCMS provides a way for the user to add/edit this list of maintenance publications.

The **Maintain Publication** option is located under the Tools menu.

4. EDITTING INFORMATION IN A PROJECT

4.1 Basic Editting Features

4.1.1 Mouse Clicks

Left clicking selects the item, function, functional failure, or failure mode that the mouse pointer is resting on.

Right clicking on any item, function, functional failure, or failure mode in the main screen of IRCMS triggers a pop-up menu that contains the following options:

- **Open** - Opens the desired screen for the currently selected item, function, etc.
- **Cut** - Cut the currently selected item
- **Copy** - Copy the currently selected item
- **Paste** - Paste a cut or copied item
- **Add Item** - Adds a new item under the currently selected item
- **Add Function** - Adds a new function for the currently selected item
- **Add Functional Failure** - Adds a new functional failure for the currently selected function
- **Add Failure Mode** - Adds a new failure mode for the currently selected functional failure
- **Mark As Historical (only available for failure modes)** – Creates a copy of the current failure mode for revision and saves current failure mode for historical purposes.

4.1.2 How To Cut Selected Information

1 Select information to be cut (text, items, functions, functional failures, or failure modes).

2 Click on  ,
or choose **Cut** in the **Edit** menu,
or choose **Cut** from the right click menu.

4.1.3 How To Copy Information

1 Select information to be copied (text, items, functions, functional failures, failure modes).

2 Click on  ,
or choose **Copy** in the **Edit** menu,
or choose **Copy** from the right click menu.

4.1.4 How To Paste Information

1 Select element to paste cut/copied information to (textual field, item, function, functional failure, or failure mode).

2 Click on  ,
or choose **Paste** in the **Edit** menu,
or choose **Paste** from the right click menu.

4.1.5 How To Delete Information

1 Select information to be deleted (text, items, functions, functional failures, failure modes).
2 Hit the **Delete Key**,
or click on **Delete** in the **Edit** menu.

4.2 How to edit an item, function, functional failure, or failure mode

Once information about an item, function, functional failure, or failure mode has been entered, IRCMS makes it easy to quickly access that information so that it can be edited:

1. Select the item, function, functional failure, or failure mode of interest.
2. Right click on the highlighted item.
3. Select **Open.**
4. Edit information.
5. Select **Save** or **Continue.**

4.3 How to edit a Task Evaluation

1. Select the failure mode of interest.
2. Right click on the highlighted failure mode.
3. Select Open.
4. Click on the Task Analysis Tab for the task that you want to edit.
5. Edit information.
6. Select Save or Continue.

4.4 Changing the Status of An Analysis

IRCMS allows you to indicate the status of an analysis at the item, function, functional failure, and failure mode levels. The input screens for each of these levels has a ***Status*** pull down menu where the user can choose from the following:

- **Approved** - analyses that are complete and have been approved.
- **Awaiting review** - analyses that are complete and are waiting for approval.
- **In process** - analyses that are still being worked on.
- **Needs update** - analyses that are known to need revisions.

Note: One additional status icon, **,** is used by IRCMS to indicate that an analysis is historical and forms a part of the analysis' audit trail. This selection does not show up in the Status pull down menu. It is automatically changed when the user makes a revision to the IRCMS analysis (see paragraph 1.4.7).

From the main screen of IRCMS, you can quickly tell the status of any failure mode from the icon that is displayed to the left of the failure mode (see icons above).

5. FILTERING THE DISPLAYED INFORMATION

5.1 How To Change Display Options

IRCMS allows the user to apply filters that limit what data is shown on screen. The data is still in the database, but it is not displayed. Using the View menu, select from the following options:

- Most Current Revisions Only
- All Revisions
- Collapse Indenture Tree View One Level
- Expand Indenture Tree View One Level

5.2 How To Collapse a Branch

The **Collapse** function hides lower level items from being displayed. The **Collapse** function works with both the hardware breakdown tree and the FMECA tree .

To collapse the entire tree one level:

- Click on  (on the tool bar),
- *or* choose **Collapse** from the **View** menu.

To collapse a specific branch one level:

- Click on ⊟ beside the branch to be collapsed.

5.3 How To Expand a Branch

The **Expand** function reveals lower level items that are hidden from view. The **Expand** function works with both the hardware breakdown tree and the FMECA tree .

To expand the entire tree one level:

- Click on  (on the tool bar),

or choose Expand from the View menu.

To expand a specific branch one level:

- Click on ⊞ beside the branch to be expanded.

This page intentionally left blank

6. PACKAGING PREVENTIVE MAINTENANCE TASKS

6.1 Packaging Window

The packaging window is where a user can organize the individual preventive maintenance tasks into executable groupings of tasks. The window lists information about the individual tasks and provides tools for filtering and sorting the data that assists an analyst in developing maintenance packages.

6.1.1 Data displayed on Packaging window

The following information is displayed on the packaging screen:

ID – Item Identifier.
FMI – failure mode indicator. Identifies the analysis failure mode.
Task code – Code uniquely identifying the task.
Task description – Description of the task.
Preliminary task interval – Analyzed repeating task interval.
Level of maintenance – Analyzed level of maintenance.
First inspection interval – Analyzed first occurrence of the task.
Packaged task interval – Packaged repeating task interval.
Packaged level of maintenance – Packaged level of maintenance.
Packaged first inspection interval – Packaged first occurrence of the task.
Package description – Description of the package that contains the task.

6.1.2 Packaging screen menus

The packaging window contains two menus.

File menu – Provides the ability to Export and Import packaging data to and from Excel.
View menu – Provides the ability to specify fields with which to *filter* and *sort* the packaging data.

The packaging data may be filtered by any of the following:

- Item
- Failure mode
- Assigned package
- Maintenance level
- A range of task intervals
- Reference publication
- **Zone/work area** (not available on packaging report)

The packaging data may be sorted by any of the following:

- Item
- Failure mode
- Preliminary task interval
- Preliminary maintenance level
- Packaged interval
- Packaged maintenance level
- Task type
- Zone/work area

6.2 Package Maintenance

When preventive maintenance tasks are packaged together into executable groups of tasks, these groupings are typically given a name such as "Phase A", "Phased Depot Package A", etc. These groupings of tasks are documented in a publication of some sort, such as an MRC deck, PMIC deck, etc.

This feature of IRCMS provides the user a way to add/edit a list of packaging group names and to assign a publication that is associated with that grouping.

The ability to assign package names makes the packaging analysis easier by allowing the user to filter and sort using package or publication names.

The Package Maintenance option is located under the Tools menu.

7. REPORTS

7.1 Producing a Report

The **Report** Menu provides access to all IRCMS reports. Each report can be output in various forms according to the needs of the user. Output options are:

- View on screen
- Send to printer
- Export to file/disk

Some reports allow the user to set filters to limit what information is included in the report. Certain reports also allow the user to control how the data is ordered by applying a sort to the report data. These functions give the user flexibility in generating a report that suits their purpose.

7.2 Available reports

IRCMS provides the following data output reports:

FMECA – FMECA data in MIL-STD-1629 format.
Packaging – Output of Packaging Analysis data based on filters and sorts chosen by the user.
Cost/Skills – Summary of the skill levels required to perform the preventive maintenance determined by RCM analysis.

7.2.1 FMECA Report Information

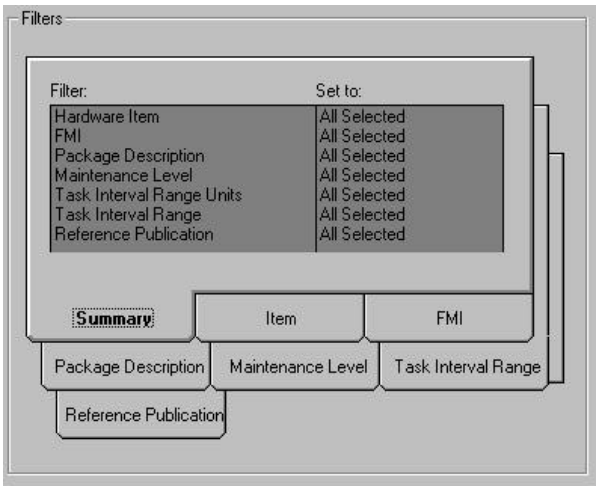
The FMECA report screen provides an interface to control what is included in the report and how it is organized.

Filters. The user chooses which items and failure modes will be included in the report by using the filter tabs that have been provided.

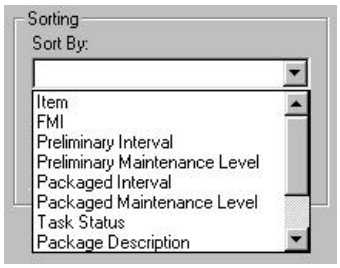
7.2.2 Packaging Report Information

The packaging report screen provides an interface to control what is included in the report and how it is organized.

Filters. The user chooses what data will be included in the report by using the filter tabs that have been provided. Each tab allows the user to limit the output based on a different field. A summary tab gives an overview of the filters that have been set.



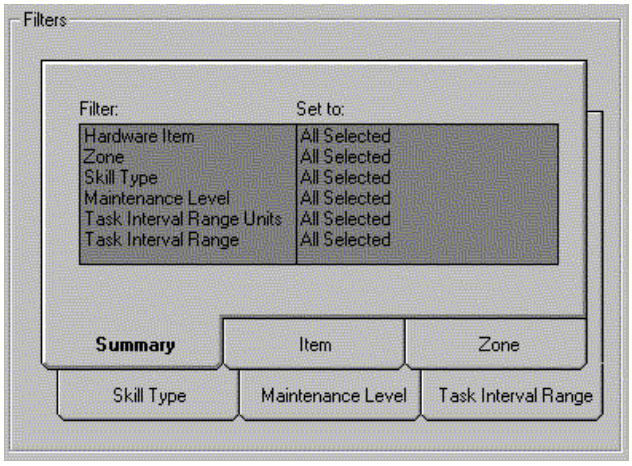
Sorting. The user also chooses how the data will be sorted on the report using a pull-down menu that lists the fields that can be used for sorts.



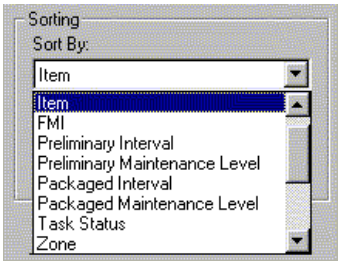
7.2.3 Cost/Skills Report Information

The Cost/Skills report screen provides an interface to control what is included in the report and how it is organized.

Filters. The user chooses what data will be included in the report by using the filter tabs that have been provided. Each tab allows the user to limit the output based on a different field. A summary tab gives an overview of the filters that have been set.



Sorting. The user also chooses how the data will be sorted on the report using a pull-down menu that lists the fields that can be used for sorts.



8. EQUATIONS USED IN IRCMS

8.1 Cost Comparisons

The Cost Analysis screen provides a place for the user to compare preventive options based on cost per unit operating.

To do this:

1. **Select tasks** - select the preventive tasks that are to be compared using the check box that is to the left of the task
2. Record task *cost per unit operating time* values– record a value for each selected task

If you are not using the built-in cost equations, enter the *Cost Per Unit Operating Time* directly into the *Stored Value* Field.

If you are using the built-in cost equations :

- Select whether preliminary or packaged intervals will be used in the calculations.
- Click --> (button to the right of the *Calculated Value* field) to store the calculated value.

Note: If ? is displayed instead of -->, click on ? to find out what data must be entered before the calculation can be used. Once this information is entered, --> should appear.

3. Record *cost per unit operating time* values for "No PM" or "Redesign" – done as described above.
4. **Record solution** - Record the chosen solution on the Summary screen.

8.2 Cost equations

The following equations are programmed into IRCMS to assist the analyst in performing cost analyses that compare one option to another. Each equation calculates a cost per operating time for the task or option.

Option	**Cost per unit operating time Equations used in IRCMS** (accessed using the **Cost Analysis** button on the failure mode screen) Note: Italicized items below are IRCMS field identifiers.
Service/Lube	**$SL_{OP} = C_{SL} / I_{SL}$** Where: SL_{OP} = Service/lubrication task cost per operating time. C_{SL} = *Cost Of One SL Task* I_{SL} = Either *Preliminary Task Interval* or *Packaged Task Interval.* User selects which interval to use in the calculation.
On-Condition	**$OC_{OP} = C_{OC} (L - I_I) / (I_{OC} * L) + C_R / MTBF$** Where: OC_{OP} = On-condition task cost per operating time. C_{OC} = *Cost Of One Inspection*. Includes cost of material, labor, etc. for inspection but not repair costs. L = *Item Design Life*. I_I = *Initial Inspection Interval* = interval of time until the first inspection I_{OC} = Either *Preliminary Task Interval* or *Packaged Task Interval.* User selects which interval to use in the calculation. C_R = *Average Repair Cost*. Average cost of repairing potential & functional failures

	assuming the inspection is in place. MTBF = Mean time between failures
Hard Time	**$HT_{OP} = C_{HT}(S) / I_{HT} + C_R(1-S) / MTBF$** Where: HT_{OP} = Hard time task cost per operating time. C_{HT} = *Cost Of One HT* = cost to perform one hard time task (AVDLR or new cost) S = *Percent Survive*. Percentage of items that survive to the hard time limit. I_{HT} = Either *Preliminary Task Interval* or *Packaged Task Interval.* User selects which interval to use in the calculation. C_R = *Average Repair Cost*. Average repair cost if HT task is not done and unit fails. MTBF = Mean time between failures
Failure Finding	**$FF_{OP} = C_{FF} / I_{FF} + C_R / MTBF$** Where: FF_{OP} = Failure finding task cost per operating time. C_{FF} = *Cost Of One Inspection* = cost to perform one Failure Finding inspection. I_{FF} = Either *Preliminary Task Interval* or *Packaged Task Interval.* User selects which interval to use in the calculation. C_R = *Average Repair Cost*. Average cost of repairing the functional failure. MTBF = mean time between failures
Age Exploration	**AE_{OP} = AE task cost per operating time** = Development and implementation cost amortized over the remaining life of the aircraft program.
No Preventive Maintenance	**$NO_{OP} = C_R / MTBF$** Where: NO_{OP} = "No PM" cost per operating time. C_R = *Average Repair*. Includes repairing the item and secondary damage caused by the failure. For hidden failures be sure to include cost of multiple failures. MTBF = MTBF of dual or multiple failures.
Other Action	**$OA_{OP} = C_{OA} / L_R$** Where: OA_{OP} = "Other action" cost per operating time. C_{OA} = Development and implementation cost of the "other action" L_R = Remaining life of aircraft.

8.3 Life Cycle Costs

The Cost Analysis screen provides a place for the user to document life cycle cost savings produced by the use of RCM.

To do this:

On the lower right of the Cost Analysis screen, enter:

1. Analysis cost
2. LCC before RCM or update
3. LCC after RCM or update

If you are not using the built-in LCC equation, enter the *LCC* directly into the *Stored Value* Field.

If you are using the built-in LCC equation:

- Click --> (button to the right of the *Calculated Value* field) to store the calculated value.

Note: If ? is displayed instead of -->, click on ? to find out what data must be entered before the calculation can be used. Once this information is entered, --> should appear.

IRCMS then calculates the LCC savings attributable to the use of RCM.

This page intentionally left blank

APPENDIX A – IRCMS' TABLE STRUCTURE

This appendix contains the table structure used by IRCMS projects. Additional table information can be obtained by opening the project in Microsoft Access and viewing the table properties. The following tables are included:

Table Name	Description
Age	Contains data for Age exploration candidates
EFM	Contains data about Failure Modes
Failure_Finding	Contains data about Failure Finding task analysis
Function	Contains data about Functions
Function_Failure	Contains data about Functional Failures
Hard_Time	Contains data about Hard Time task analysis
Item	Contains data about Items (End item, systems, sub-systems, etc.)
On_Condition	Contains data about On-Condition task analysis
Package	Contains data about Packages defined in the project
Ref_Pub	Contains data about Reference Publications defined in the project
Servicing_Lube	Contains data about Servicing and Lubrication task analysis
Status	Contains data about the Status categories used in IRCMS
Summary	Contains Summary RCM analysis data
User	Contains User information

Table name: *Age*

Name	Type	Length
ID	Number	4
Code	Text	4
Description	Text	254
Interval	Number	8
Interval_Units	Text	2
First_Inspection	Number	8
First_Inspection_Units	Text	2
LOM	Text	1
Sample_Size	Number	8
Percent_Of_Fleet	Number	8
Duration	Number	8
Duration_Units	Text	2
Task_Cost	Currency	8
Man_Hours	Number	8
Material_Cost	Currency	8
Avg_Cost_Repair	Currency	8
Cost_Per_Op_Time	Currency	8
Task_Status	Text	20
Card_WP_Num	Text	10
Item_Para_Num	Text	10
Zone	Text	20
Status	Number	4
Priority	Number	4
Accept_Task	Yes/No	1
EFM_ID	Number	4

Table name: *EFM*

Field Name	Type	Length
ID	Number	4
Code	Text	2
Rev	Text	1
Description	Text	254
Local_Effects	Text	254
Next_Higher_Effects	Text	254
End_Effects	Text	254
MTBF	Number	8
MTBF_Units	Text	2
Detection_Method	Text	254
Severity_Class	Number	2
Safety	Number	2
Evident_Hidden	Number	2
Memo	Memo	-
Effectivity	Text	50
WUC_Part_Num	Text	32
Damage_Type	Text	1
Damage_Tolerant	Number	2
Interchangeable	Number	2
Life_Comp	Number	8
Life_Comp_Units	Text	1
End_Item_Life	Number	8
Status_ID	Number	4
Analyst_ID	Number	4
Approved_By	Number	4
Approved_Date	Date/Time	8
Function_Failure_ID	Number	4

Table name: *Failure_Finding*

Field Name	Type	Length
ID	Number	4
Code	Text	4
Description	Text	254
Interval	Number	8
Interval_Units	Text	2
LOM	Text	1
P_Interval	Number	8
P_Interval_Units	Text	2
P_LOM	Text	1
Task_Cost	Currency	8
Man_hours	Number	8
Material_Cost	Currency	8
Package_ID	Number	4

Task_Status	Text	20
Card_WP_Num	Text	10
Item_Para_Num	Text	10
Zone	Text	20
Skill_Type	Text	20
Avg_Cost_Repair	Currency	8
Cost_Per_Op_Time	Currency	8
Accept_Task	Yes/No	1
EFM_ID	Number	4

Table name: *Function*

Field Name	Type	Length
ID	Number	4
Code	Text	2
Description	Text	254
PSF_Code	Number	2
Memo	Memo	-
Effectivity	Text	50
Item_ID	Number	4
Status_ID	Number	4
Analyst_ID	Number	4
Approved_ID	Number	4

Table name: *Function_Failure*

Field Name	Type	Length
ID	Number	4
Code	Text	1
Description	Text	254
Comp_Provisions	Text	254
Memo	Memo	-
Effectivity	Text	50
Function_ID	Number	4
Status_ID	Number	4
Analyst_ID	Number	4
Approved_ID	Number	4

Table name: *Hard_Time*

Field Name	Type	Length
ID	Number	4
Code	Text	4
Description	Text	254
Life_Limit	Number	8
Life_Limit_Units	Text	2
Percent_Survive	Number	8
Interval	Number	8

Interval_Units	Text	2
LOM	Text	1
P_Interval	Number	8
P_Interval_Units	Text	2
P_LOM	Text	1
Task_Cost	Currency	8
Man_Hours	Number	8
Material_Cost	Currency	8
Package_ID	Number	4
Task_Status	Text	20
Card_WP_Num	Text	10
Item_Para_Num	Text	10
Zone	Text	20
Skill_Type	Text	20
Avg_Cost_Repair	Currency	8
Cost_Per_Op_Time	Currency	8
Accept_Task	Yes/No	1
EFM_ID	Number	4

Table name: *Item*

Field Name	**Type**	**Length**
ID	Number	4
Code	Text	26
Type	Number	2
Name	Text	50
Description	Text	254
Alt_App	Text	2
Part_Num	Text	32
WUC	Text	7
Num_In_Op	Number	4
Item_Life	Number	4
Item_Life_Units	Text	20
Memo	Memo	-
Analyst_ID	Number	4
Analysis_Date	Date/Time	8
Approved_ID	Number	4
Status_ID	Number	4
Effectivity	Text	50
Item_ID	Number	4

Table name: *On_Condition*

Field Name	Type	Length
ID	Number	4
Code	Text	4
Description	Text	254
Potential_Failure	Text	144
Functional_Failure	Text	144
IPF	Number	8
IPFUNIT	Text	2
Interval	Number	8
Interval_Units	Text	2
First_Inspection	Number	8
First_Inspection_Units	Text	2
LOM	Text	1
P_Interval	Number	8
P_Interval_Units	Text	2
P_First_Inspection	Number	8
P_First_Inspection_Units	Text	2
P_LOM	Text	1
Task_Cost	Currency	8
Man_Hours	Number	8
Material_Cost	Currency	8
Package_ID	Number	4
Task_Status	Text	20
Card_WP_Num	Text	10
Item_Para_Num	Text	10
Zone	Text	20
Skill_Type	Text	20
Avg_Cost_Repair	Currency	8
Cost_Per_Op_Time	Currency	8
Accept_Task	Yes/No	1
EFM_ID	Number	4

Table name: *Package*

Field Name	Type	Length
ID	Number	4
Name	Text	50
Ref_pub_ID	Number	4

Table name: *Ref_Pub*

Field Name	Type	Length
ID	Number	4
Name	Text	50
Description	Text	254

Table name: *Servicing_Lube*

Field Name	Type	Length
ID	Number	4
Code	Text	4
Description	Text	254
Interval	Number	8
Interval_Units	Text	2
LOM	Text	1
P_Interval	Number	8
P_Interval_Units	Text	2
P_LOM	Text	1
Cost	Currency	8
Man_Hours	Number	8
Material_Cost	Currency	8
Package_ID	Number	4
Task_Status	Text	20
Card_WP_Num	Text	10
Item_Para_Num	Text	10
Zone	Text	20
Skill_Type	Text	20
Cost_Per_Op_Time	Currency	8
Accept_Task	Yes/No	1
EFM_ID	Number	4

Table name: *Status*

Field Name	Type	Length
ID	Number	4
Description	Text	50

Table name: *Summary*

Field Name	Type	Length
ID	Number	4
No_PM	Yes/No	1
No_PM_Avg_Repair_Cost	Currency	8
No_PM_Cost_Per_Op_Time	Currency	8
Analysis_Cost	Currency	8
LCC_Old	Currency	8
LCC_New	Currency	8
LCC_Savings	Currency	8
Memo	Memo	-
Redesign	Yes/No	1
Redesign_Cost	Currency	8
Redesign_Cost_Per_Op_Time	Currency	8
EFM_ID	Number	4

Table name: *User*

Field Name	**Type**	**Length**
ID	Number	4
Last_Name	Text	50
First_Name	Text	50
Access_Level	Number	2
User_name	Text	50
Password	Text	50
Active	Yes/No	1

This page intentionally left blank

APPENDIX B – GLOSSARY OF FIELDS

B-1. Fields That Show Up On Multiple Screens

The following fields show up on the Item and FMECA related screens.

Fields	Definitions
Effectivity	Identifies a specific group of end items on which this item/function/functional failure/EFM is used.
Analyst	Analyst name.
Approved by	Name of person approving this analysis.
Status	Status of this part of the analysis.
Measurement base	Units of number entered to the left.

B-2. FMECA Related Screens

Item Screen Fields

Fields	Definitions
Item Id	Unique identifier for the item.
Item name	Descriptive name of the item.
Item description	Description of the item.
Wuc	Work unit code.
Part number	Part number of item.
Alternate application	Alternate application. User defined code that distinguishes between multiple uses of the same item on the same end item (eg. Distinguishes between the same item used on right and left sides of end item).
Number of items in operation	Number of items currently in operation.
Item design life	Design life of this item.

Function Screen Fields

Fields	Definitions
Function Id	Alphanumeric characters that uniquely identify the function of the current item.
Functional description	Description of the function the item provides. Description should be detailed enough to distinguish this function from other functions of the item.

Functional Failure Screen Fields

Fields	Definitions
Functional failure Id	Alphabetical characters that uniquely identifies the functional failure of the current function.
Functional failure description	Description of this specific functional failure. Description should be detailed enough to distinguish this functional failure from other functional failures of the function.
Compensating provisions	Any redundancies, protective features, or fail-safe design features that protect against loss of the function or act to mitigate serious consequences upon functional failure.

Failure Mode Screen Fields

Fields	Definitions
FMI	Failure mode indicator - Alphanumeric characters that uniquely identify the engineering failure mode of the current functional failure. Automatically assigned by IRCMS, but may be changed by the user.
FM description	Description of the specific engineering failure mode that causes the current functional failure. Description should be detailed enough to distinguish this engineering failure mode from other engineering failure modes of the functional failure.
Local effects	Effects that the engineering failure mode has on the item under analysis.
Next higher effects	Effects that the failure caused by the engineering failure mode has on the system/sub-system/etc. that contains the item under analysis.
End effects	Effects that the failure caused by the engineering failure mode has on the end item.
Detection method	Methods by which the functional failure is detected and the engineering failure mode is identified.
Severity class	Rating of the severity of the failure mode.
MTBF	Mean time between failures caused by this specific engineering failure mode.
Part no of failed item	Part number or work unit code of the failed item. Only used if this analysis is being done in response to an engineering investigation.

Failure Consequence Screen Fields

The failure consequence screen contains two sets of radio buttons for determining the failure consequence category of each failure. Select appropriate buttons based on the following questions:

> **Evident/Hidden** - " Is the functional failure, or effect of the failure mode, on its own, evident to the operator while performing normal duties?"
>
> **Safety/Non-safety**
>
> > **Evident failures** – "Does the occurrence of the failure mode cause a function loss or secondary damage that could have an adverse effect on operating safety?"
> > **Hidden failures** – "Does the occurrence of the hidden failure mode in combination with a second failure/event cause a function loss or secondary damage that could have an adverse effect on operating safety?"

Answering these questions determines the failure consequence category that the engineering failure mode is assigned.

B-3. Task Evaluation Related Screens

Common Task Evaluation Screen Fields

Fields	Definitions
Task Id	Unique identifier for this task. Useful when an engineering failure mode has more than one effective task option.
Task description	Description of this task. Identify in the task description the item that maintenance is being performed on, what is being done (action), and specific conditions being looked for (inspections only) or measured (AE).
Preliminary task interval	Task interval that comes from analysis of failure mode data.
Preliminary LOM	Lowest level of maintenance that is required to perform the task.
Packaged task interval	Task interval that results from considering all preventive maintenance requirements for an item and choosing the best interval at which to package and execute the task.
Packaged LOM	Level of maintenance that will perform the preventive requirement at the packaged interval.
Man-hours	Man-hours required to perform the task.
Material cost	Cost of consumable materials used to perform the task.
Task cost per unit op time	Cost of performing the task per unit of operating time.
Task Accepted	Indicates whether this task was chosen to prevent the failure mode. This decision is made on the Summary tab after all options have been considered.

Service/Lube Task Screen Fields

Fields	Definitions
Cost of one SL task	Cost of performing one servicing or lubrication task.

On-Condition Task Screen Fields

Fields	Definitions
Potential failure condition	Potential failure condition that can be inspected for. Should be specific, e.g. "0.4 inch . . .", "first indication of . . .".
Functional failure condition	Description of the condition that defines the functional failure currently under analysis.
Potential to functional failure interval	The time/age interval that occurs between the potential and functional failure conditions.
Prelim initial inspection	The time a new item can remain in-service before the initial periodic inspection is performed. Periodic inspections begin at this time and continue for the life of the item.
Packaged initial inspection	The time at which the preliminary initial inspection is packaged.
Average cost of repair	Average cost of repairing potential & functional failures assuming the inspection is in place.
Cost of one inspection	Cost of performing one inspection task. Includes cost of material, labor, etc. for inspection but not repair costs.

Hard Time Task Screen Fields

Fields	Definitions
Wearout age/Life limit	The age at which the conditional probability of failure rapidly increases.
Average repair cost	Average cost to repair damage done if hard time task is not done and item fails.
Cost of one HT	Cost of performing one hard time task (AVDLR or new costs).
Percent survive	Percentage of units that survive to the wearout age.

Failure Finding Task Screen Fields

Fields	Definitions
Average repair cost	Average cost to repair the functional failure and any damage done when item fails.
Cost of one FF task	Cost of performing one failure finding task.

Age Exploration Task Screen Fields

Fields	Definitions
Task interval	Repeating interval at which the AE task should be done.
Initial inspection	Interval of time before the first repeating inspection is carried out.
Task duration	Planned duration of AE task. Task should last only as long as required to gather enough data with which to make decisions.
LOM	Lowest level of maintenance that can do the AE task.
AE priority	Priority given to this AE task.
AE status	Status of AE task.
Sample quantity	Number of sample items required to obtain results representative of the entire population under consideration.

Sample % of fleet	Percentage of the fleet required to obtain results representative of the entire fleet.
Cost of one inspection	Cost to perform one AE task.
Average repair cost	Average cost to repair damage found during this AE task.

Cost Analysis Screen Fields

Fields	Definitions
Analysis cost	Cost of RCM analysis.
LCC before RCM	Life cycle cost before performing/updating RCM analysis.
LCC after RCM	Life cycle cost after performing/updating RCM analysis.
LCC savings	Life cycle cost savings due to performing/updating RCM analysis.
No PM average repair cost	Average cost to repair failure when it occurs.
No PM cost per unit op time	Cost of allowing item to fail in service per unit operating time.
Total cost	Cost of developing and implementing the "other action".
Other action cost/ unit op time	Cost of developing and implementing the "other action" per unit operating time.

Package/Summary Screen Fields

Fields	Definitions
Package	Pick list of "packages" that the user has added to the package list (see "maintain package" on tools menu)
Incorp status	Pick list showing status categories representing the status of the RCM justified PM task's incorporation into the maintenance program.
Document	Maintenance document in which the RCM justified PM task is documented/implemented.
Card/wp	Card or work plan on which the RCM justified PM task is documented/implemented.
Item	Item that the RCM justified PM task is performed on.
Zone	Zone in which the RCM justified task is to be performed.
Skill	Skill level required to perform the RCM justified task.

This page intentionally left blank

Index

F

H

I

L

M

N

O

P

R

S

T

U

W